SURVIVAL AND RETURN TO CREEL OF APACHE TROUT

FINAL REPORT
HERITAGE PROJECT (I92046)

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ABSTRACT

Native Apache trout Oncoryhynchus apache were stocked in streams on the Fort Apache Indian Reservation. Fish that were stocked from May through September 1993, in the East Fork of the White River had a 34% survival rate in October, 1993, and a 3% survival rate in June, 1994. A number of stocked trout emigrated upstream. Proportion of exotic trout did not decrease from June 1993 to June 1994 and still make up the majority (71%) of trout numbers in Spring of 1994. Catch rates ranged from 0.76 to 0.97 fish per hour and were consistent through out the summer. One section had a significant increase in catch rate from August (0.56 fish/hour) to September (2.45 fish/hour) in 1994, perhaps due to a drop in water temperature. Estimated return rates of Apache trout was variable among stream sections (12-30%) and closely related to angling pressure. Thirty six hundred 11-13 inch Apache trout were stocked in one section in 1994 to determine if return rates would increase. Return rates did not change significantly from 1993 (31%) to 1994 (28%). Rainbow trout Oncoryhynchus gairdneri (mean size 350 gms) were stocked with marked Apache trout (mean size 100 gms) on July 22, 1993, to determine differences in return rates. Rainbow trout returned to the creel in significantly higher numbers (48%) than Apache trout (2%) in the first three days. After the first three days return rates were similar for rainbows (0.06 fish/hour) and marked Apache trout (0.03 fish/hour). Return rates for Apache trout could be increased by stocking fish earlier in the year, only stocking streams with good returns and educating anglers on how to catch Apache trout.

INTRODUCTION

The White Mountain Apache (Tribal) and the Arizona Game and Fish Departments signed a Heritage Agreement on April 14, 1993. The Tribal Game and Fish Department agreed to start a study on the effects of stocking eight inch Apache trout (Oncoryhynchus apache) in streams in return for partial funding. The objectives of the study were to: 1) Determine the survival of 8 inch trout in the streams, 2) Determine if there is a decline in exotic trout (brown trout Salmo trutta and rainbow trout Oncoryhynchus gairdneri) with stocking of Apache trout, and 3) Determine the return to creel of stocked trout in the streams. Two other studies were done in addition to the required objectives. Creel surveys were done on one stream in summer of 1994 to determine if stocking larger fish would improve creel returns and a comparison was made on one weekend in 1993 to determine if there was a difference in return rates between Apache and rainbow trout. This report briefly explains methods, presents results and discusses results of the objectives of the study.

STUDY SITES

The East Fork of the White River (Figure 1) was chosen as the study site to determine survival

of Apache trout and declines in exotic trout. This stream is fairly small with an average low flow in the summer of 7 cfs. The drainage is relatively narrow and ranges from 3200 meters to 1800 meters (total area is 39 square miles). Spring runoff is relatively prolonged because a high proportion of the drainage is at high elevations. The study area is located where the stream enters a broader valley; the area above the stocking area is basalt with plunge pools. The riparian zone is well developed with overhanging vegetation, especially cottonwoods. Ground cover is not as dense as the over story; vegetation is shaded out by the over story and there are areas that are bare because of heavy recreation use. This area is used during the day for recreation (mostly picnics), especially by tribal members. Fishing use is fairly light and there is little over night camping.

All stocked streams were used to determine return to creel of Apache trout (Figure 1). There are twenty-six miles of streams managed as put and take on the reservation. Management areas for stocking are: Paradise Creek (1 mile), North Fork at McCoys (2 miles), North Fork at Upper Log (5 miles), North Fork at Lower Log (2 miles), North Fork at Alchesay Hatchery (3 miles), Diamond Creek (3 miles) and the East Fork (6 miles). Cibecue Creek has four miles of put and take fishery but was excluded from this study because it was too far from the other streams to do creel surveys on a regular basis. Anglers who fish streams in the upper part of the reservation (north of Lower Log) tend to camp near the stream, live in Tucson or Phoenix, and have a wide range in angling skill. Anglers who fish the lower part of the stocked area (south of Lower Log) are tribal members, fish the streams a couple hours in the evening, and tend to have a lot of skill with fishing bait.

Streams run through basalt formations. Although most of the streams are characterized by plunge pools with large boulders, the stocked areas have flatter topography with about half the stocked area being plunge pools and the other half being fairly large riffle/run areas with large pools at bends in the stream. Overhead vegetation is generally thick with Ponderosa being the dominate vegetation in upper streams and cottonwoods in lower streams.

For the past forty years, these sections of streams were all managed as a put and take rainbow fisheries. Fish were stocked twice a week in the summer months until September of 1990. Rainbow trout of various strains were raised to eight inches before stocking. In May of 1991, rainbow trout were replaced by similar numbers of Apache trout. Apache trout spawn late and grow slower in the hatchery than rainbow trout. Therefore, the hatcheries were unable to meet objectives of eight inch trout; average length of stocked trout ranged from 7.3 to 8.2 inches. This study started in spring of 1993 so there may have been some effect on exotic trout from Apache trout stocking in 1991 and 1992.

METHODS

Stocked Apache trout were from the East Fork Strain and were spawned at Williams Creek Hatchery in Spring of 1992. Fish averaged 7.3 to 8.2 inches at stocking. Fish were raised at the Williams Creek Unit and were stocked out of either Williams Creek or Alchesay Federal Fish Hatcheries. Numbers of fish stocked is presented in Table 1.

Table 1. Number of stocked Apache trout and summer temperature range in streams of the Fort Apache Reservation in summer of 1993 and 1994. Temperature was measured at stocking.

Stream	1993 Stocked (Fish #)	1993 Temp (F)	1994 Stocked (Fish #)	1994 Temp (F)
		HIGH COUNTRY		
NORTH FORK				
Lower Log (F)	13350	45-64	13225**	51-70
Upper Log (G)	18100	45-64	19415**	51-71
McCoy's (H)	12100	45-68	9579**	55-70
Ryan's Ran (I)	0			55-64
Ditch Camp (I)	100		100**	
PARADISE CREEK				
Paradise	3500	53-68	3250	56-68
Sum	43650		44470	
		LOW COUNTRY		
NORTH FORK				
Whiteriver (A)	2925	56-59*	975	59-63
D. Creek to bri	6135	50-70	2967	59-65
Below Hatch (D)	4935	50-65	3559	58-65
EAST FORK				
Betwe bridge (A)	3775	47-62	1300	56-62
Rock Creek (B)	6050	47-62	1900	54-60
DIAMOND CREEK				
Above confl (A)	3300	50-66	2950	55-63
Sunflower (B)	2750	48-64	1175	54-61
Sum	29870		14814	

* June temperatures only

** 8500 of these fish were two years old with an average length ranging from 11.3 to 13.1 inches.

Survival of Stocked Trout

Nine thousand eight hundred and twenty five trout were fin clipped and stocked into the East Fork by the U. S. Fish and Wildlife Service. Fish were stocked in equal numbers from May through August in eight kilometers (from site 3 to site 6) of the East Fork (Figure 2). The East Fork had eight 50 meter study sites that were two kilometers apart. Two of these sites were located below stocked areas, four within the stocked area, and two above the stocked area. These study sites were sampled in October of 1993 to determine summer mortality and June of 1994 to determine annual mortality. An additional two sites were sampled above the original site in June of 1994. These sites were sampled to determine the extent of Apache trout migration upstream of the original eight sites. Fish were captured by electroshocking; two passes were made so that population estimates could be made (Zippen 1958). From the original eight sites, estimates were extrapolated for the entire study reach (16 kilometers).

Creel surveys were conducted to estimate the number of trout that were harvested by anglers from May through August.

Reduction of Exotic Trout

Numbers of exotic trout were recorded at the eight sites. The eight sites were sampled in June of 1993 and June of 1994. The proportions of exotic trout to total trout in the stream sites were estimated in 1993 and 1994 to determine if their was a reduction in exotic trout with Apache trout stocking. A categorical test of binomial proportion was used to determine if changes were statistically different. Unfortunately, some of the data for three sites of 1993 were misplaced; calculations were done on the five completed sites.

Return to Creel of Stocked Trout

Fish were stocked from mid May through the first week in September at one week intervals (upper streams) or two week intervals (lower streams). Seventy four thousand eight inch Apache trout were stocked in summer of 1993 at the study streams. Fifteen thousand eight inch Apache trout and thirty-six hundred larger Apache trout (ten to fourteen inches) were stocked into Upper Log in the summer of 1994.

All stocked streams on the east side of the reservation were sampled by creel clerks for number of anglers and catch rates. Streams were sampled on twelve randomly selected days per month. Days were not stratified by weekend or weekdays because previous creel surveys on the reservation had shown no significant difference in use. Sampling was done from either 0800 to 1600 hr or 1200 to 2000 hrs. In 1993, the survey period went from May 1 to September 1.

Creel surveys were continued in 1994, but only the Upper Log section of the North Fork was sampled. This creel survey was not required under the original contract, but I was curious to determine if stocking larger trout would improve return rates. Period of sampling was changed

because the 1993 survey over represented midday hours from 1200 to 1600 hours; period of sampling was either 0700 to 1300 hours or 1300 to 2000 hrs. In 1994, the survey period went from June 1 to October 1.

Harvest of fish was calculated by multiplying observed catch rates (fish/hour), by pressure (angler/ hour), times the total amount of hours during the season. Estimates of daily catch rate were calculated as the ratio of all trout caught by all anglers at the stream reach to the sum of all hours fished by anglers at the stream reach. Estimates of daily catch rates with less than five hours of fishing were not used to calculate monthly or season catch rates.

Return Rate of Apache Versus Rainbow Trout

Six hundred and fifty rainbow trout (average size 350 gms) from Jimmy Joy's hatchery at Blue, Arizona and a nine hundred fin clipped Apache trout (100 gms) were stocked on July 22, 1993, in the Upper Log section. Anglers were surveyed continuously for three days to get immediate return rate. Return of these fish after the initial three days was recorded by the regular creel surveys of twelve days per month.

RESULTS AND DISCUSSION

Survival of Stocked Trout

Stocked Apache trout had a survival rate of 34% three months after stocking and a survival rate of 3% nine months after stocking (Table 2.). About 11% of the fish were lost to the creel. These estimates suggest 55% of the trout were lost by mid October to emigration, hooking mortality, natural mortality, or angler harvest in September and October. By June 1994, 97% of the trout were lost to natural mortality, harvest, and emigration.

Emigration was not an objective of this study, however, our shocking data suggest fish were moving upstream. Stocked Apache trout were found in disproportionate numbers upstream of the stocking area compared to downstream areas in both October of 1993 and June of 1994 (Table 2). I sampled an additional two sites (9 and 10) two and four kilometers above the original sample sites in Spring of 1994 to determine if stocked trout may be emigrating upstream out of the sample area. This sampling suggested stocked trout moved upstream but not great distances. Trout would move upstream two to four kilometers but were limited in numbers above four kilometers (less than 5% of total stocked trout numbers; Table 5). The upper four kilometer above the stocking sites were included in estimates of survival, therefore, emigration in the four kilometers above stocking sites would not cause low estimates of survival.

Conversely to these results, Heimer et al. (1985) and Fay and Pardue (1986) found that catchable rainbow trout were more likely to move downstream than upstream and stated that most previous studies found similar results. Few trout moved downstream in this study (Table

2). The East Fork is too warm for trout within four kilometers of the lowest site sampled. If trout migrated downstream after stocking they were probably lost to natural mortality.

Table 2. Fate of fish stocked in East Fork in Summer of 1993.

	Number of fish	Proportion%
Stocked (May-Aug)	9825	100
Harvested (May-Aug)	1081	11
Sampled Oct 93		
Below stocking	200	
At stocking	1408	
Above stocking	1700	
Total	3308	34
Sampled Jun 94		
Below stocking	0	
At stocking	20	
Above stocking	240	
Total	260	3

Table 3. Fish captured at sites in October of 1993.

	S. trutta	O. apache	Total
Below stocking area			
Site 1	4	5	9
Site 2	2	2	4
In stocking area			
Site 3	2	10	12
Site 4	4	13	17
Site 5	3	12	15
Site 6	1	13	14
Above stocking area			
Site 7	16	37	53
Site 8	I8	26	44
TOTAL	50	118	168

Few (<10%) of Apache trout died from hooking mortality and September and October harvest.

Hooking mortality was low because their was little fishing pressure on the East Fork. Less than 5% of the stocked fish would have been lost to hooking mortality, assuming a release rate of 0.34 fish per hour (calculated from the creel survey) and 100% hooking mortality. Trout harvest in September and October was not measured. If harvest levels were consistent with summer months it would add another 5% to mortality.

Natural mortality was probably the main cause of mortality of the trout stocked. Stocked trout are poorly adapted to stream environments: they expend a lot of energy in dominance displays and often occupy poor feeding sites. Trout at poor feeding sites often expend more energy than they capture (Fausch 1984). Trout with low energy reserves are especially susceptible to winter mortality (Hunt 1969). This may explain why Apache trout numbers decreased ten fold over the winter (Table 2). There may have been some mortality from predators: a five pound brown trout was captured at one location.

All trout stocked in streams are subject to high mortality. Therefore, the question becomes does a wild Apache trout survive longer than more domesticated hatchery trout. Survival rates were high compared to other stream stockings. Fay and Pardue (1986) stated that most fish were absent four to eight week after stocking. Heimer et al. (1985) stocked 8,000 rainbow trout in 1979: he captured 3% of the fish in October, 0.25% of the fish returned to the creel the next summer.

In my opinion, Apache trout survived well in the stream and are in adequate numbers to provide fishing through the fall. Stocking these trout is useful in areas with light fishing pressure because they can provide fishing two to three months after stocking.

Reduction of Exotic Trout

The hypothesis was that the proportion of exotic brown trout would decrease after stocking of Apache trout. In fact, the proportion of exotic trout increased from 47% in Spring of 1993 to 68% in Spring of 1994. This 21% increase was not statistically significant. Total fish numbers increased from 8 to 15 exotic trout (Tables 4 and 5). I would not say that the stocking of Apache trout caused brown trout numbers to increase. Number of fish sampled at sites 1 through 5 were so low that it is hard to make conclusions. These lower sites were probably poor habitat for trout because of warm water or summer stocking. Stocking in streams has been shown to have a negative correlation on wild trout biomass (Vincent 1987). Sites higher in the drainage (Sites 7 through 10) had higher numbers of trout. It appears that exotic trout are not being displaced because they still make up 81% of the trout numbers at these higher sites.

These sites will have to be monitored in the future to determine changes in numbers of exotic trout. This study has too short a time frame to determine displacement of brown trout by Apache trout; a study of five years is more appropriate. Personally, I do not think stocking of Apache trout will displace brown trout. Rainbow trout were stocked in these streams for over forty years and did not displace brown trout.

I also looked for evidence of recruitment at the sites. Two fish under 150 mm were captured during shocking; these fish may not have been recruitment but poor growing hatchery fish. I have observed some hybrid Apache trout x rainbow trout in the East Fork so their may be some recruitment in the streams.

Table 4. Fish captured at sites in Spring of 1993.

	Catostomids	S. trutta	O. apache
Below stocking area			
Site 2	9	1	0
In stocking area			
Site 3	2	2	0
Site 4	14	2	4
Site 5	8	3	1
Site 6	15	0	4
TOTAL	48	8	9

Table 5. Fish captured at sites in Spring of 1994.

	Catostomids	S. trutta	O. apache
Below stocking area			
Site 1	15	7	0
Site 2	7	2	0
In stocking area			
Site 3	7	0	1
Site 4	10	2	0
Site 5	11	5	0
Site 6	7	6	6
Above stocking area			
Site 7	3	18	13
Site 8	1	23	3
Site 9	0	21	1
Site 10	0	23	1
TOTAL	61	107	25

Return to Creel of Stocked Trout

Return to the creel is a function of angler catch rates times angler pressure. Therefore, I will present the results of catch rate, angler pressure and harvest.

Catch rates were high in summer of 1993 and ranged from 0.62 to 1.57 fish per hour in the high country and 0.31 to 1.69 fish per hour in the low country (Table 6). I broke up the areas into four geographic areas for statistical purposes. The areas and their catch rates from high to low elevations are:

McCoy's-Paradise campground (0.97 fish per hour: 90CI of 0.73 to 1.21)
Upper Log (0.77 fish per hour: 90CI of 0.63 to 0.93)
Lower Log (0.76 fish per hour: 90CI of 0.58 to 0.94)
Low Country (0.97 fish per hour: 90CI of 0.77 to 1.17).

Apache trout were the majority of trout caught except in Diamond Creek. Apache trout made up an especially high proportion in the high country (72 to 96%).

Table 6. Catch rates (fish caught per hour) in streams of the Fort Apache Reservation in summer of 1993. APT is stocked apache trout kept, wild is wild fish (brown trout or rainbow trout) kept, release is the number of fish released and total is the sum of the three previous catch rates.

Stream	APT (fsh/hr)	Wild (fsh/hr)	release (fsh/hr)	total (fsh/hr)
		HIGH COUNTRY		
NORTH FORK				
Lower Log (F)	0.31	0.13	0.32	0.76
Upper Log (G)	0.40	0.18	0.19	0.78
McCoy's (H)	0.50	0.07	0.34	0.97
Ryan's Ran (I)	0.06	0.02	0.54	0.62
Ditch Camp (I)	-	-	1.17	1.17
PARADISE CREEK				
Paradise	0.99	0.04	0.49	1.57
		LOW COUNTRY		
NORTH FORK				
Whiteriver (A)	0.26	0.10	0.10	0.49
D. Creek to bri	0.10	0.10	0.10	0.31
Below Hatch (D)	0.42	0.16	0.22	0.94
EAST FORK				
Betwe bridge (A)	0.73	0.45	0.34	1.69
Rock Creek (B)	0.62	0.0	0.27	0.88
DIAMOND CREEK				
Above confl (A)	0.41	0.66	0.18	1.25
Sunflower (B)	0.15	0.15	0.77	1.08

Catch rates of 0.8 to 1.0 meet the objectives in the tribal fish management plan. Catch rates were high throughout the summer months: June (0.64 to 1.07 fish per hour), July (0.88 to 1.18 fish per hour), and August (0.59 to 1.24 fish per hour) (Table 7). These catch rates were higher than the catch rates in the put and take lakes over the summer (WMAT 1994). Therefore, Apache trout were able to perform throughout the summer and have potential as a put and take stream fish.

Table 7. Catch rates for streams on the fort Apache Indian reservation by month in summer of 1993. Parenthesis show 90% confidence intervals.

	Apache kept	Total kept	Total caught
Mcoy's-Paradise			
May	0.16(0.0-0.53)	0.16(0.0-0.53)	0.24(0.0-0.59)
June	0.51(0.12-0.90)	0.58(0.18-0.98)	0.88(0.34-1.41)
July	0.25(0.0-0.63)	0.54(0.25-0.84)	1.18(0.69-1.67)
August	0.73(0.22-1.24)	0.86(0.37-1.36)	1.24(0.79-1.70)
Total	0.45(0.26-0.65)	0.59(0.40-0.78)	0.97(0.73-1.21)
Upper Log			
May	0.34(0.13-0.56)	0.47(0.29-0.64)	0.51(0.34-0.68)
June	0.48(0.26-0.69)	0.69(0.43-0.95)	0.89(0.54-1.23)
July	0.49(0.29-0.69)	0.67(0.45-0.90)	0.95(0.66-1.24)
August	0.16(0.0-0.34)	0.40(0.06-0.75)	0.59(0.12-1.06)
Total	0.40(0.30-0.50)	0.59(0.47-0.70)	0.78(0.63-0.93)
Lower Log			
May	0.23(0.0-0.56)	0.39(0.06-0.72)	0.70(0.0.-1.39)
June	0.33(0.04-0.62)	0.44(0.12-0.77)	0.64(0.28-1.00)
July	0.33(0.15-0.51)	0.46(0.26-0.67)	0.88(0.57-1.19)
August	0.38(0.0-0.89)	0.46(0.0-1.08)	0.89(0.16-1.62)
Total	0.31(0.19-0.43)	0.44(0.30-0.57)	0.76(0.58-0.94)
Low Country			
May	0.47	0.65	0.76
June	0.61(0.25-0.97)	0.90(0.50-1.31)	1.07(0.74-1.40)
July	0.32(0.02-0.63)	0.79(0.39-1.18)	1.03(0.53-1.53)
August	0.40	0.45	0.81
Total	0.44(0.29-0.60)	0.75(0.56-0.94)	0.97(0.77-1.17)

Catch rates for Upper Log in 1994 (0.73 fish per hour 90CI 0.52-0.94) were similar to 1993 (0.78 fish per hour 90CI 0.63-0.93). Catch rates by month seemed to differ between years with highest catch rates in July in 1993 and June and September in 1994 but it was not statistically

significant (Table 7). Summer of 1993 was a lot wetter and cooler than 1994, further studies may need to be done to determine the effect of temperature on return rates. McMichael and Kaya (1991) found that stream temperatures over 19 C had a negative affect on angling success in Montana streams.

In 1994, catch rate in September was significantly higher than in July and August. Lower water temperatures in September probably influenced the increase in catch rate. This high catch rate after stocking ceased in the summer suggests that stocking Apache trout may be a valuable tool to meet catch rate objectives in the fall.

Table 8. Catch rates (fish/ hour) and confidence intervals (90%) by month at Upper Log Campground , Fort Apache Indian Reservation.

	1993	1994
May	0.51 (0.34-0.68)	-
June	0.89 (0.54-1.23)	1.06 (0.53-1.57)
July	0.95 (0.66-1.24)	0.63 (0.34-0.92)
August	0.59 (0.12-1.06)	0.56 (0.28-0.86)
Septem	-	2.45 (1.34-3.56)

Angling pressure was variable among the stream sections and ranged from 7 anglers per hour at Upper Log to less than 1 anglers per hour in the low country streams (Table 9.) Angling pressure in 1994 for Upper log was similar to 1993 with 6.5 anglers per hour (Mann-Whitney 90CI 5.5 to 8.0 anglers per hour). Angling use by month is presented in Appendix I.

Return rate of Apache trout ranged from less than 1% in some of the low country sections of stream to 31% at Upper Log. Rate of return was a function of angling pressure with streams with the highest pressure having the most harvest. Geographic areas and their harvest rates from high to low elevations were:

McCoy's-Paradise campground (20%: 90CI of 11 to 33%)
Upper Log (31%: 90CI of 19 to 41%)
Lower Log (19%: 90CI of 10 to 28%)
Low Country (10%: 90CI of 4 to 17%)

Rate of return was lower than I would like. Wiley et al. (1993) summarized rate of return for thirty- four Wyoming streams and found an average of 27.5% with a range of 8 to 65%. Rohrer (1987) reported rates of 3 to 20% in sections of the Henry's Fork, Idaho. Conversely, Moring (1985) reported consistent harvest rates of 62 to 82% on Oregon streams

Some reasons for the low harvest rate were: 1) the small size of fish stocked (34% of all caught trout were returned); 2) the fact that large numbers of trout were stocked in stream sections that had low angling pressure; 3) the fact that a lot of fish were stocked in August when angling pressure was low, 4) and the fact that Apache trout did not readily take bait. Apache trout were

stocked in equal numbers for each month. Stocking a higher proportion of fish in July instead of August (when fishing pressure is low) would increase return rates. Heimer et al. (1985) reported harvest rates of 55 to 63% of May stocked fish and harvest rates of 15 to 23% for July stocked fish in a Idaho stream; he attributed the discrepancy to lower angling effort in July.

Upper Log had similar harvest rates in summer of 1993 (31%) and summer of 1994 (28%). Therefore, stocking thirty six hundred incentive fish in 1994 increased the creel rate a statistically non significant amount (from .40 to .423) but did not increase angling use. Harvest rate in 1994 may not be comparable with 1993 because their was no data collected in May 1994.

Table 9. Return of stocked Apache trout in streams of the Fort Apache Reservation in summer of 1993. HPUE is harvest of stocked Apache trout per hour. Percent return was calculated by dividing harvest by fish stocked.

Stream	Use (ang/hr)	HPUE (fish/hr)	Harvest (fish)	Stocked (Fish #)	Return (%)
		HIGH COUNTRY			
NORTH FORK					
Lower Log (F)	4.20	0.31	2533	13350	19.0
Upper Log (G)	7.02	0.40	5522	18100	30.5
McCoy's (H)	3.35	0.50	3283	12100	27.1
Ryan's Ran (I)	0.51			0	
Ditch Camp (I)	0.21			0	
PARADISE CREEK					
Paradise	0.74	0.99	1423	3500	40.7
Sum	15.31	0.41	12761	43550	29.3
		LOW COUNTRY			
NORTH FORK					
Whiteriver (A)	0.60	0.26	309	2925	10.6
D. Creek to bri	0.15	0.10	30	6135	0.5
Below Hatch (D)	0.85	0.42	692	4935	14.0
EAST FORK					
Betwe bridge (A)	0.26	0.73	372	3775	9.8
Rock Creek (B)	0.59	0.62	709	6050	11.7
DIAMOND CREEK					
Above confl (A)	1.08	0.41	864	3300	26.2
Sunflower (B)	0.15	0.15	45	2750	1.6
Sum	3.68	0.44	3021	29870	10.1

Return Rate of Apache Versus Rainbow Trout

Rainbow trout returned to the creel at a statistically significant ($p<0.0001$) higher rate (48%) than Apache trout (2%) for the first three days after stocking. Return from July 22 to September 1, 1993 was similar for rainbow (22%) and Apache trout (11%). Some of the difference in catch rates between species can be attributed to the larger size of rainbow trout compared to the Apache trout. However, more rainbow trout were kept over the three days (311 fish) than total trout released (223 fish). Other studies have found that less domesticated trout are less susceptible to the creel than domesticated trout and are not readily caught on bait (Fay and Pardue 1986; Dwyer 1990).

Table 10. Fish caught from July 22 to July 24, 1993 at Upper Log campground.

	Number of fish
Creeled fish	
Rainbows	311
Apaches (marked)	15
Apaches (unmarked)	100
Not seen	23
Released fish	223*

* Anglers reported 22 of these fish were rainbow trout and 16 were marked Apache trout.

Conclusions

Apache trout had good survival in comparison to catchable trout in other studies, especially over the summer. Overwinter survival was low which is similar to other studies of catchable trout. Apache trout were found disproportionately upstream from stocking areas, unlike previous studies on catchable trout in streams.

This study did not find evidence that stocking Apache trout will remove exotic trout. Their was evidence of recruitment (a few hybrid Apache trout x rainbow trout) but I would contend it is ecologically insignificant.

Apache trout have potential to meet management needs as a put and take fish in streams. Advantages of stocking Apache trout were: they provided a good catch rate throughout the summer, they survived well in the stream (over a three month period), and they provided good fishing in the fall. Disadvantages of Apache trout were: they did not provide a good return rate

and they did not return as fast to the creel as rainbow trout. There are a few management strategies that would help to offset disadvantages with Apache trout, they are:

1) Stock during times of heavy angling use. Data in the appendix should be used to fine tune stocking.
2) Stock streams in proportion to angling use.
3) Educate anglers on what gear is most effective on Apache trout.
4) Conduct further studies to determine the effect of temperature on return rates.

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